The Market for Internet-based Procurement Systems

Content Management and Electronic Catalogs

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This research was supported by The EARP Program under Federal Contracts 1999-2000 N00244-00-C0034 and 2000-2001 N00244-00-C0108

Content

Electronic catalogs and content management

Electronic catalogs form an essential part of electronic procurement systems, as they provide electronic access to items and services that can be purchased online. A wide variety of solutions is available today, ranging from stand-alone single-vendor product listings – the electronic equivalent of traditional paper-based catalogs – to sophisticated databases, merging data from a multitude of sources as a fully integrated part of large scale desktop procurement applications.

In the following section, we provide an overview of electronic catalogs and the issues that they include. After outlining the basic functionality, we discuss different ways of how these features appear in products, before we introduce a number of different business models, which are then evaluated, with the help of a number of variables.

Functionality

To describe individual systems in a consistent way and to provide an outline of the functionality of electronic catalogs we use four main features: storage, search and retrieval mechanisms, connectivity with providers and users of the catalog data, and administrative tools. These features answer questions, such as

- What formats and tools are used to present and store the data in the database?
- What mechanisms are provided to search the database and retrieve information?
- How is the catalog being fed with data and how can the users of the data connect to it?
- Which tools are being provided to manage the data and allow access to it?

The systems that exist today combine these features in many different ways into unique solutions. Figure 1 provides an overview of the functionality of catalog systems, which is described in further detail below.

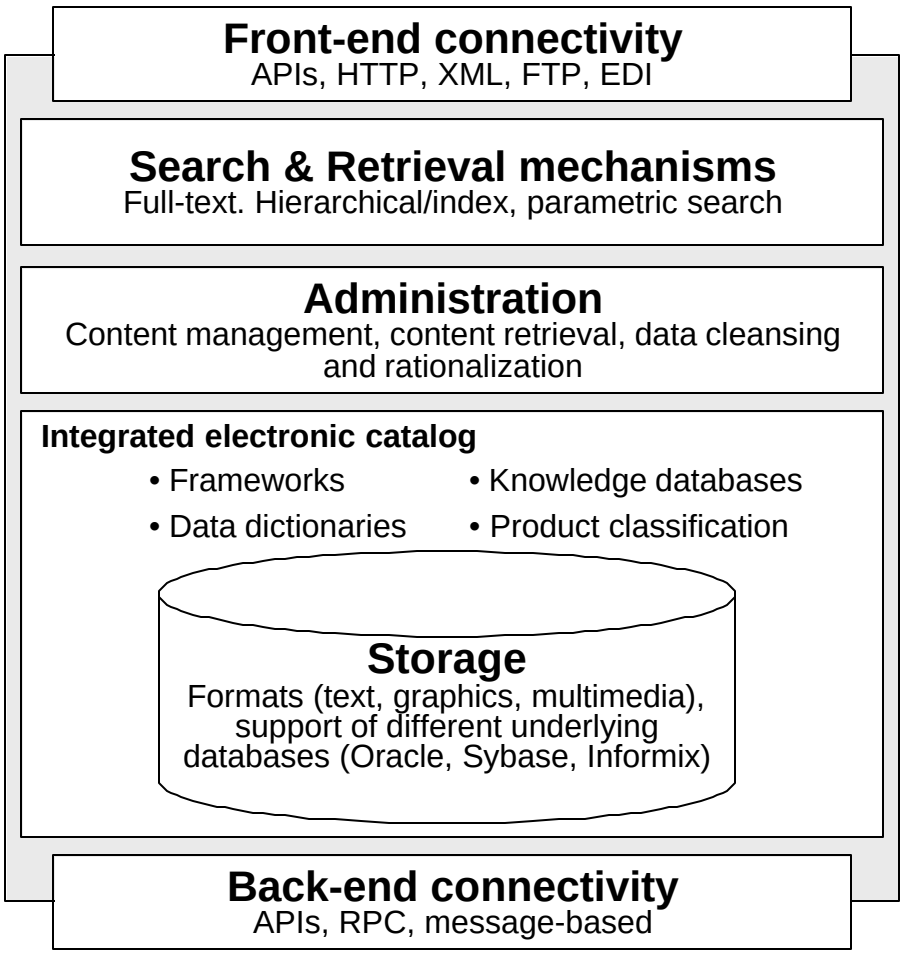

Figure 1 - Functionality of Catalog Systems

Storage

Compared to traditional paper-based media, electronic catalogs increase the range of data formats that can be used to display information about products, services, and companies. In addition to text and simple graphics, multimedia formats are available that include JPEG and GIF to display graphics, AU and WAV for audio files, and AVI, QuickTime, and RealTime to display movie clips. Different solutions can be distinguished according to which data formats they support.

Similarly, catalog solutions differ with respect to which and how many different databases they support to store catalog data. While some systems use proprietary databases, coupling them tightly with the data itself, others provide open interfaces that offer a range of choices among a number of readily available database solutions, such as Oracle, Sybase, or Informix.

Search & retrieval mechanisms

In addition to the basic data, catalog systems provide mechanisms to search through the database and retrieve information. Three basic systems can be distin-

guished: Full-text, hierarchical/index, and parametric search. In addition, hybrid models are feasible.[1]

- In *full-text search models*, the results of a search match exactly with the text string that a user typed. The method is well suited for cases where users are looking for specific products, as it quickly provides a list of research results that match the search criteria. Usually, multiple words can be provided in the search request, which allows narrowing the range of possible results. Since the search request has to match the data entries exactly, too many or too few returns are the result in cases where the user is not familiar with the specific terminology of a catalog. No guidance is provided to help users if they do not know what a specific product or product feature is called, in particular in cases where abbreviations are used. For example, what is blk standing for, black, bulk or something else? How can I search for pound: #, lb, or pound?
- In *hierarchical search models* data is organized according to a classification scheme. Users to navigate through the tree until they retrieve the desired information. The model is suited best for users that are somewhat familiar with the catalog content and can relate to the different categories. Given that names and categories are presented to the user, no guesswork is necessary in order to match the data entries. Catalog managers can decide on a classification scheme that is familiar to the users, provide indexes, and include specific attributes for branches of the tree in order to help refining the search. On the downside, the solution could be hard to use if buyers are not familiar with the terminology of the classification scheme, and using the search model tends to take longer than using the full-text model. Also, the hierarchy needs to be maintained to account for shifts in classification, which means extra management efforts
- *Parametric search models* provide some interpretation of user requests. Users describe products using attributes, which is then transformed into database queries. Attributes are unique characteristics that describe items based on a high level category. This method is considered the best model for matching a product to a specific need, as it can account for spelling errors to some extent, and offers interactive guidance through the catalog database by making connections between synonymous data entries. It is expensive, though, as the additional attribute layer requires a significant amount of data transformation and strong discipline in order to keep clean, consistent data. In addition, the list of items can be unnecessarily limited in cases where not enough up-front consideration is put into the attribute schema.[2] Limits for the use of this model apply to items that cannot easily be described with a pre-defined set of attributes, such as complex services.

Hybrid models combine parts of the basic methods. For example, they can offer text searches but return products and product categories. This method is used like full-

[1] See Olsen-presentation, Berkeley Procurement Forum 4/7/99

[2] Enabling Data for Electronic Commerce, White Paper, ProcureNet, 4/9/99

text searches to find specific products, but also yields the advantages of hierarchical models, such as the possibility to use attributes to refine searches.

Connectivity

Different mechanisms and formats exist to upload the data and establish the link between data sources and electronic catalogs. Similarly, connectivity with the end-users of the data is realized in different ways.

Some methods that are used to upload data electronically have been around for many years, such as FTP and EDI. The Web allows setting up solutions that are user-friendlier or even interactive, e.g., through CGI-enhanced HTML-forms and real-time, automated connections based on open programming interfaces (APIs). Some catalogs accept data in pre-defined formats that are openly published, such as the Catalog Interchange Format (CIF), others are based on proprietary formats. To support the automated uploading of data into catalog databases, emerging standards, such as XML are expected to play a more important role in the future.

Ariba, a provider of desktop procurement applications, is cooperating with Microsoft to integrate its cXML tag-set for e-procurement into Microsoft's XML-based BizTalk framework.[3] cXML provides tags to support supplier content and catalog models, including transaction information for purchase orders change orders, status updates and payment. BizTalk provides an umbrella framework for integrating applications and business processes between users.

Upon launching its BizTalk initiative, Microsoft promised to support any XML schema written using the BizTalk guidelines. To comply with these guidelines, Ariba will rewrite the next version of cXML using the XML-Data Reduced spec, which Microsoft has submitted to the WWW Consortium as a potential alternative to today's XML Data Type Definitions (DTDs).

Catalog solutions can also be distinguished with respect to the links into internal systems that they support. Again, a wide range of solutions exists. Stand-alone systems display catalog-data on the screen only, while integrated solutions provide close links with different modules of backend enterprise systems, such as general ledger, accounting, or human resources. Localized solutions differ from distributed systems that allow access to catalog data from a number of different locations.

Administration

In addition to the basic database, catalog solutions often provide additional tools for data management and administration. As one of the most important features of modern catalogs, available solutions can be distinguished by the mechanisms they provide to merge data from different sources into a larger whole. Some systems offer support to accomplish this task in automated fashion, while others require much

[3] Richard Karpinski: E-Commerce Tools, Standards Alleviate Catalog Headaches, Internetweek, May 17, 1999

human intervention, or cannot handle data integration at all. Somewhat related is the question, which mechanisms are used to convert data from different sources into the electronic format of choice. Some catalog providers have developed efficient ways to convert paper-based catalog-data into electronic files by using scanning techniques (Requisite), while others can extract data from spreadsheets or even Web sites (webMethods).

Similarly, systems differ with respect to the question whether they support individual views of the catalog data, to be arranged according to user profiles or individual information needs. Again, a wide variety of possibilities exist, ranging from very simple methods of compiling copies of the full data sets manually to sophisticated solutions that can generate individual views dynamically by pulling information directly off backend systems. Shrinking the set of data that is visible to the individual user allows exerting some control, but can also help improve the efficiency of individual users who are provided with a set of catalog data that best fits their needs.

Products and services to set up catalogs and manage content

Virtually all of the electronic functions that we introduced above can be managed in-house by the user of the catalog, as well as be acquired from third party software vendors and service providers.

Some examples and representative marketplayers:

- set up catalog databases (Flow Systems for media independent databases, Oracle for database technology)
- manage connectivity between suppliers and the catalog (Ariba.com, Harbinger.com for data uploading)
- rationalize data (ProcureNet, TPN Register, SourceSys)
- manage and publish catalog content (Requisite)
- manage catalogs and catalog data that have been published to external sites (FactPoint to certify and validate content and product data published to Web sites and partner extranet sites)
- manage internal and external connectivity of catalog users (Sterling for integration of catalogs with corporate business processes and suppliers, e.g., EDI)

Comprehensive catalog solutions can be set up by turning to a single vendor only, or by combining products and services from a number of different providers. The large number of vendors and services that cover the different aspects of setting up the databases and managing the data reflects the importance of electronic catalogs as an essential part of electronic commerce systems and innovative procurement solutions. But it also shows clearly the difficulties of some of the tasks in this context, in particular regarding content aggregation and management.

Catalog content integration and content management

Electronic catalogs often provide access to data from different sources (manufacturers, distributors, or internal data sources). Unified access to catalog information requires the integration of data of different origin, which again calls for content that is clean and consistent.

Almost all companies in the business of selling items have product data in some electronic format. However, there is a difference between the data that evolved over time in legacy systems or print design applications, and the type of data that is needed for online catalogs. The difference is that buyers are now linking to product data directly, be it through a supplier web site or by using a purchasing application. In most cases, catalog content needs to be prepared for users that are not familiar with the original data and its specific terminology. Parametric search engines, in particular, require clean data and a consistent use of the attribute layer in order to map user requests to the original data records.

Attributes are unique characteristics that describe an item based on a high level category. For a pen, for example, attributes could be color, tip-type, or manufacturer. By assigning attributes to an item, catalog data becomes more consistent, structured, and easier to search and manage. After assigning the attributes, a stable implementation and use of the attribute values has to be assured. Inconsistencies lead to difficulties of retrieving data of a given product.

Data cleansing and rationalization is usually very expensive and labor-intensive as it involves much manual work. Frequent errors are the result. A number of attempts have been made to alleviate this task, including vendors, such as ProcureNet, RosettaNet, an initiative of the IT industry, or Dun & Bradstreet's schemas to categorize products and corporations.

ProcureNet

ProcureNet, a provider of procurement software propagates its Common Language Generator (CLG) a tool that supports data cleaning by utilizing a knowledge database. The tool helps to transform existing material descriptions into one standard description format and uses pattern recognition to identify attributes and produce standardized format values. The knowledge base contains 90,000 rules for over 2,000 families of goods and services, representing over 1.5 million discrete items. One such rule could be: "Valve: Gate" = "Gate Vlv" = "Gt Valve." New knowledge is incorporated in the database as new matches come up. The tool allows automated data cleansing and content management to some extent.

Harbinger, TPN Register, and SourceSys (partnering with Commerce One on its MarketSite-product) have similar approaches.

RosettaNet

RosettaNet is an initiative of the IT industry to standardize Web data formats and schema for use and reuse among manufacturers, distributors, retailers and users of corporate IT products.[4] Standardization efforts are being done on several levels, including the development of data dictionaries (similar to defining the meaning of words in real language), frameworks (XML DTD's), Partner Interface Processes (PIP, defining business and data models to set up dialogs), and business processes.

At the lower level, the outcome includes database descriptions for products such as laptops, peripherals or software, as well as definitions for presenting IT products in electronic catalogs. The standard promises to let resellers present to buyers, products from multiple manufacturers without extensive modification, while allowing them to use their existing product numbers and pricing schemes. As a result, distributors would gain a better handle on inventory management. Manufacturers can gain tools for creating a standard catalog that could be used to gain access to activity across the supply chain.

The initiative is headed by IT distributor Ingram Micro and includes major technology manufacturers, such as Cisco Systems, Compaq, Hewlett-Packard, and IBM. In addition, software publishers (Microsoft, Oracle, SAP), Resellers (CompuUSA, EDS, Insight), technology providers (GEIS, pcOrder), wholesale distributors besides Ingram Micro (TechData, Tech Pacific), Endusers (ABB, AMEX, GSA), and financial institutions (Deutsche Financial) are part of the multi-year project.

Dun & Bradstreet

Dun & Bradstreet (D&B) has developed catalog codes for businesses and commodity products and services. It's UN/SPSC codes,[5] which are endorsed by the United Nations (UN), and DUNS numbers are among the best-established categorization schemas currently available. The product code is based on a hierarchical structure and is provided to the general public for free. D&B generates revenues by providing services to businesses to map their proprietary, internal catalogs according to the public code schemes. This process is supported with artificial intelligence-enhanced matching software that D&B has patented.

The company also helps businesses rationalize procurement data by cleansing vendor masters and product codes. In its business database D&B is listing 50 million businesses and 6 million business and their links to other companies in terms of financial ownership.

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[4] Group Forms To Create Internet Trading Standards, (04/03/98, 8:19 p.m. ET), By John Evan Frook, InternetWeek, see also www.rosettanet.org

[5] http://www.unspsc.org

Aspect Technology is competing with D&B in terms of cleaning up product and supplier databases, while Thomas Register, a provider of manufacturer and product directories, uses a competing product classification schema.

Scope

Available catalog solutions range from stand-alone systems (in their simplest form: CD-ROMs) replacing paper-catalogs and enhancing them with more sophisticated search mechanisms etc., up to complex catalog systems that are fully integrated into desktop procurement applications, such as the ones that we introduced in the previous section. Solutions in between cover parts of the functionality, such as connectivity services, data conversion, content management and data cleansing, or catalog hosting. Data management and value added network services are offered alongside with software solutions and hardware equipment.

Similarly, the connections with the existing backend-architecture can take many forms. Catalogs can be linked with internal requisitioning systems facilitating the online-submission of an order between end user requisitioner and central purchasing, internal approval routing and order handling, online ordering from suppliers, order tracking, and payment. Automating the links with a subset of these functions can actually have a relatively fast payoff if the individual situation of the firms is taken into account properly (where are the greatest inefficiencies, exactly?), including the existing IT-architecture. Even stand-alone systems help reduce errors and increase the speed of procurement processes that used to be based on paper. Catalog systems can provide some support for approval processes, e.g., by displaying a set of pre-approved products from a set of pre-approved vendors that are available for procurement to a certain user group. More sophisticated solutions provide workflow support and facilitate automated approval routing, either as part of the catalog system or by linking with backend systems (ERP).

Step-wise solutions turn out to be a wise choice in many cases, as they allow a firm to start out with a simple (and cheap) system to be improved subsequently. In this context, a situation of being stuck with a particular solution needs to be avoided, e.g., by using open standards and components that are relatively well established, thus, supported by a number of complementary systems.

Business Models

The different functions of electronic catalogs can be combined in many different ways with the various product offerings, resulting in a large number of different business models. Each of the models reflects the unique set of intentions that the particular group has to join the market.

Software vendors and system integrators view the catalog market as the primary outlet for products and services, either as main products or in addition to and to promote an established line of offerings. Value added network providers, for example, have long provided support for companies to get online. At times where the growth rate of traditional EDI connections is low, they are searching for new outlets

to sell their online services. The Internet provides a welcome new medium to leverage the skills in ramping up suppliers and integrating content from various sources. Additional offerings include data translation and mapping services, as well as methods to establish links between the catalogs and data sources (Ariba.com).

Suppliers and distributors are interested in the Web and the Internet an innovative and potentially very efficient channel to sell products and services. Even buying corporations enter the market sometimes, trying to leverage the investment in new technologies by offering their systems and experience to newcomers. In some cases spin-offs have been formed (IBM Global Procurement).

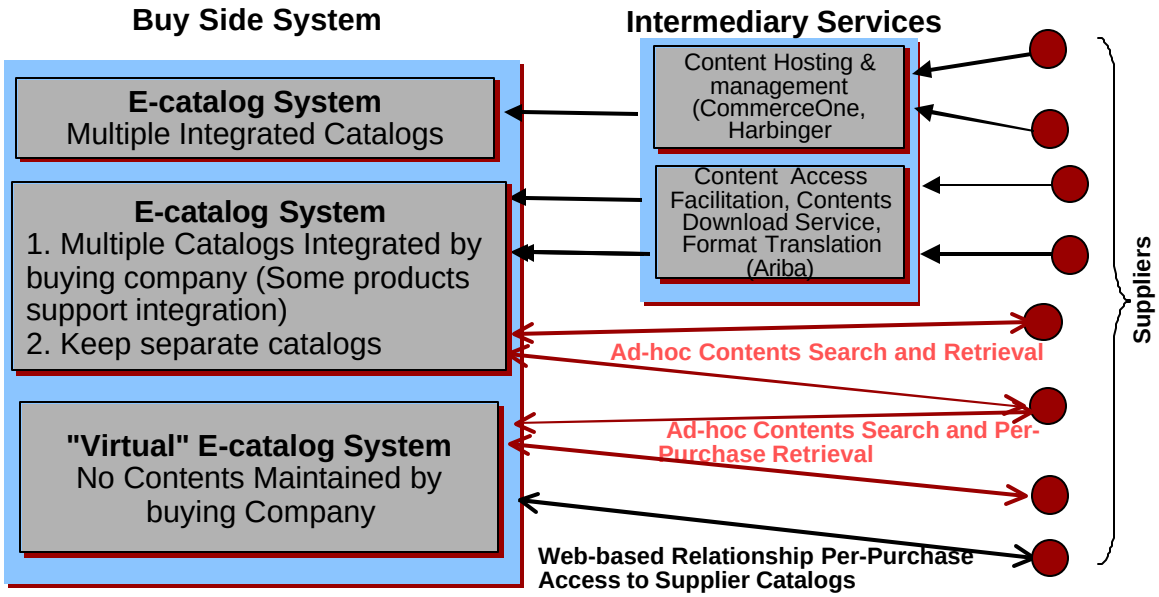

Figure 2 – Electronic Catalogs and Contents Management

In the following, we categorize the different business models according to the amount of catalog integration that they involve, and distinguish between two basic catalog models: single-vendor catalogs display the offerings of one vendor only, while multi-vendor catalogs integrate data from several vendors and data sources (see Figure 2 for an overview). Catalogs of both models can be hosted and managed at the seller side, transferred to the buyer side or managed by a third-party service provider. In addition, combined solutions are quite common. Systems that primarily support the selling process are also termed sell-side solutions, while buy-side solutions provide support for purchasing processes.

Single-vendor catalogs and sell-side solutions

In their simplest form, from the perspective of catalog content integration, electronic catalogs provide access to the data of one supplier or distributor only. Single-vendor catalogs (usually to be categorized as sell-side solutions) provide the online counterparts of traditional paper- or CD-ROM-based catalogs. They make product data available electronically through supplier Web-sites or as parts of Internet-

based shopping malls and virtual megastores. While sellers maintain and control the catalog data, buyers access the site and search through the offerings. More sophisticated solutions also provide secure access through Extranets, support for Requests for Proposals (RFPs) and bidding processes, online ordering, reporting, and payment functionality. Often the offerings are completed with additional information as pre-negotiated pricing levels, current leadtimes, product specs, and technical training, as well as links to external sources. Beyond the catalog information, integrated supply and demand management solutions include inventory management services and services beyond responding to individual orders from customers. Table 1 provides an overview of the market of single vendor catalogs and sell-side solutions.

Table 1 – Single vendor catalogs and sell-side solutions

Functionality	Listings of products and services, search & retrieval mechanisms, connectivity methods, and basic administration tools. In addition, possibly: • Customization of catalog content and look & feel of the Web site, e.g., limiting access to certain items, providing pre-negotiated contract pricing, and complying with the general look & feel of the general web site • Ordering functionality (online, fax, e-mail, etc.) • Access to backend ordering/customer-service system enabling real-time information on prices, availability, current leadtimes, product specifications, delivery status • Buy-side front-end including approval functionality; integration with customer's front-end and backend systems • Extranet, secure access, digital certificate
Representative market players	W.W. Grainger, Boise Cascade Office Products, Newark Electronics (customized catalogs for commodity items, integration with buy-side systems), Ingram Micro Inc. (channel assembly, Web-based front-end applications, content categorization)
Target customers	Services and applications are primarily targeted towards existing customer base. Buy-side system integration and front-end applications, in particular, are aimed at larger customers where end-to-end procurement automation can lead to significant time and cost savings.
Business model	Revenues are generated from licensing fees and increased business. Savings in cost and time are realized through streamlined processes and increased process automation
Strengths and weaknesses	Real-time information available, low maintenance for the customer since supplier/distributor maintains content and manages updates. Comprehensive sites through links with suppliers of complementary items possible. No control over catalog content for the buying organization, often no direct links or real time integration with buyers' internal systems
Overlaps with other categories	Electronic markets (bringing together many suppliers with many buyers), multi-vendor electronic catalogs and catalog management services
Evaluation	Suppliers/distributors are usually skeptical of complete market transparency and trend to channel visitors to their own offerings. Comprehensive solutions increase customer value.

	XML-tags promise a solution for the decision problem of where to locate inter-organizational catalogs. They allow buying companies to parse and extract exactly the information from a supplier catalog that is necessary for its individual purposes.

To establish and manage sell-side solutions, a growing number of software vendors and service providers offer support, ranging from software to set up virtual storefronts to physically hosting the data and processing transactions. According to Forrester Research, sell-side applications accounted for the largest slice of revenues in electronic commerce licensing fees in 1997 (47%, $57 million). The research firm expected this share to grow to $1.4 billion by 2002.

Sell-side solutions are often set up by large distributors of commodity items, who themselves have a long record of selling products from many different manufacturers. They usually cater to particular industries (e.g., electronics, manufacturing) or specialize in certain product categories (e.g., office supplies, MRO items).

W.W. Grainger

William W. Grainger founded W.W. Grainger in 1927 in Chicago as a store to sell electronic motors. Today the company has 11,800 employees and distributes more than 200,000 products for areas, such as maintenance, repair, testing, and construction. The annual report shows more than $3 billion in annual sales.

Products are made available through a general paper catalog, 2.6 million copies of which are distributed each year, on CD-ROM, and through the Internet.

In addition to its different catalogs, Grainger is developing software tools and services to support online transactions and internal buying processes. In order to improve the links between its catalog and procurement systems it has established alliances with a number of software and service providers. Among them are Requisite Technologies for catalog and content management, SAP and other ERP vendors for ERP integration, and Perot Systems to integrate third-party catalog content into Grainger's electronic catalog.

Grainger is a good example of a supplier/distributor trying to improve its basic catalog service by including additional features. For example, buying corporations can be provided with customized views of the general catalog, reflecting individually negotiated prices and conditions. Additional features include online ordering and support for approval processes via business rules. Finally, Grainger gathers and stores information on procurement processes of large customers and on the use of the items that are purchased.

Newark Electronics

Newark Electronics distributes electronic components throughout North America. The company is a subsidiary of UK-based Premier Farnell, a global distributor of

MRO supplies and specializes in small orders and hard-to-find and discontinued parts for the maintenance and repair market.

Newark's catalog contain data from over 350 franchised vendors and allows access to around 300,000 parts that Newark has in stock.

Until 1996, Newark used paper-based catalogs only to present its products, distributing about 1 million per year. Since then, a CD-ROM version has been published, as well as a Web-based online catalog. For both venues, Newark had to develop a new database as a central access point to the catalog information. Traditionally, the different data sources were not integrated and often data was of such low quality that it could not possibly be provided to external users.

In addition to the general catalog, Newark customers are also provided with customized catalogs that reflect individual pricing and contract arrangements. Add-on features include online ordering, direct links with suppliers (EDI, Internet), tracking services, reporting, and contract management. Links with third party4 catalog consolidators have been established, such as Intelisys, Harbinger, Fisher Technologies, SmartWorks, Elcom, Trade-Ex, Ariba, and TPN Register. In addition, Newark supports third party solutions for order management, and specialized broker and buying services.

Newark has announced to support common standards such as UN/SPSC, XML, and OBI in future versions of its offerings.

Ingram Micro

High-tech distributor Ingram Micro Inc. is headquartered in Santa Ana, California. The company has about 12,000 employees and annual revenues of $16.6 billion.

Ingram uses Internet technology to realize a concept called channel assembly. This concept enables its customers to use Internet applications to specify the components of a computer they purchase. Dell Computer Corp. and Gateway 2000 are making use of the concept. Others, such as Compaq, Hewlett-Packard, and IBM demand channel assembly from its distributors. With the channel assembly program, Ingram also seeks to serve the needs of major retailers and resellers like CompUSA Inc.

Ingram aims at collapsing production cycles and reduce inventories throughout the supply chain. It is developing Internet-based frontend applications that can either be accessed from its Web site or from reseller sites. With these applications, customers as well as salespeople can compare products, get current price information based on agreements, and check availability. Ingram also developed its own middleware to integrate Web applications with its backend system and licensed third party software for secure online transactions over the Internet.

The company plays a leading role in the RosettaNet initiative, an effort to standardize product information across the IT industry. (Internetweek, October 26, 1998, John Evan Frook, “Webifying the Channel”)

Boise Cascade

Boise Cascade was established in 1957 by a merger of two Northwestern lumber companies and is headquartered in Boise, Idaho. Today, it is a major producer of pulp and paper, a distributor of office products, and a manufacturer and distributor of building products. Its subsidiary Boise Cascade Office Products uses the Internet and emerging technologies extensively to support the distribution of office products. I-97, its Internet ordering system had 1,200 customers at the end of 1997.

In addition to its Internet system, Boise also receives orders from customers via EDI; through its PC- or LAN-based system called CEO; by e-mail; and through direct access to the company's host computer. This system allows customers into the host system as it would a customer-service rep.

Boise also has an office supply database listing more than 200,000 products (Internetweek, November 9, 1998) complementing the company’s offerings of catalogs on customer intranets. Similar to desktop purchasing applications, Boise lets requisitioners select products from an intranet-based catalog, which are then ordered directly from the supplier via an extranet-link. Digital certificates and HTTP host forms (asking the customer for information that identifies him) help recognize the requisitioner as customer. Once the requisitioner selects his items, the supplier sends a shopping cart back to the intranet for necessary company approvals. The requisition then is converted to a purchase order and sent back to the supplier via a traditional EDI system.

BT Office Products

BT Office Products International (BT OPI), a distributor of office supplies, based in Buffalo Grove, Ill., enhances its online catalog with features to support buying and selling processes. The offering includes an Internet ordering system called SyntraNet, which is accessible through a standard Web browser; SMARRT, a system that operates on a company's PC LAN (local area network) or WAN (wide area network); and EDI, for customers with their own purchasing systems. BT OPI also provides catalog information to third-party catalog management services such as Commerce One, Ariba, and TPN.[6]

[6] http://www.manufacturing.net/magazine/purchasing/archives/1998/pur0423.98/042offic.htm (office supplies goes online, Purchasing Magazine, April 1998).

Staples

Office supplies distributor Staples has established a dial-direct system that connects to its customer-service system. With this system, customers have access to the same screen that the company's service reps use. The system provides customers with real-time information, online ordering, and tools for tracking and reporting. Staples also supports requests for product information used in customized electronic catalogs and receipt of orders from customers' proprietary EDI systems.

Accounting for the unique needs of its customers, Staples offers five different electronic commerce systems. The offerings include PC Link, a CD-ROM-based product that operates on a PC or LAN. With PC Link, customers may place orders via facsimile or telephone. Its Tel Link product is an automated voice-response system. Using the telephone, customers type in SKUs (stock keeping units) and quantities required of the products they're ordering. Staples also is pilot testing a new Internet product with customers who already have agreements in place with the distributor. The different offerings can be combined into solutions that meet individual requirements and match existing IT infrastructure. For example, customers can use proprietary EDI systems at one location and place orders over the telephone at other locations.

Summary

Others distributors that are also very aggressive in deploying Internet technologies, include Fisher Scientific and VWR Scientific Products for laboratory equipment (the latter using Chemdex at its online arm), or electronic components manufacturer National Semiconductor.[7]

The single vendor approaches demonstrate the attempts of large distributors to keep and strengthen their intermediary position between their supplier-manufacturers and buyer-customers. Establishing an online-catalog is a relatively inexpensive solution from the distributors' perspective, but potentially rewarding as it provides an additional outlet for their products and services. The central catalog is set up once, and can then made available to many buyers (potentially in a customized version). The vendors keep control, not only of the data and format that the data is represented (including the look and feel of the site), but also of the customer information.

Buyers gain access to up-to-date information on a 24/7-basis. In cases where online ordering and other purchasing functions are supported, supplier lead-times can usually be shortened compared to conventional buying processes. Large distributors have recognized the need of buying firms for individual catalog solutions. Most of the market players that we introduced can provide customized subsets of their full catalogs accounting for individual contracts and pricing arrangements. The

[7] http://www.manufacturing.net/magazine/purchasing/archives/1998/pur0813.98/081net.htm

systems can also link with backend systems and support internal approval rules to some extent. Still, from a technical standpoint, the solutions are usually not quite as advanced as dedicated systems by e-procurement providers.

Another point might weigh even heavier, though. Single-vendor systems are usually not connected with catalog offerings of other distributors. This leaves the buying firm with the burden of having to integrate the data and applications from a number of different sources in order to provide a common interface if unified access to a number of suppliers is to be established.

Multi-vendor catalogs

Multi-vendor electronic catalogs integrate information from several suppliers by merging data and performing some degree of semantic reconciliation. The data is then presented to the buying firm as a centralized access point to the products and services that can be purchased electronically. This centralization can be physical (e.g. housed inside the firm) or virtual (appearing to be located in one database, although in fact agent technology gathered the components and aggregated them in real time). To the selling participants, it represents a way to infiltrate a wide variety of markets and exploit possible synergies with the other selling parties. In addition, a catalog integrator may bundle the offering with other features to make the aggregated catalog more attractive.

Multi-vendor catalogs can be distinguished according to the amount of data overlap that they contain. In cases where the individual catalogs of complementary suppliers are combined into a larger whole, one supplier only covers each category of products. This situation alleviates the task of content integration significantly compared to the more complicated case where a catalog contains content from competing suppliers. In that case, individual product descriptions have to be transformed into a consistent format. As we pointed out, data cleansing and rationalization, i.e., assigning meaningful attributes to the catalogs items, can be a very cumbersome and expensive task (see the section on content management).

We identified three basic models of multi-vendor catalogs to support procurement, representing the most common ways that companies choose today: the “Do-It-Yourself” approach, the “Third-party integrator” approach, and the “Real-time knowledge discovery” approach.[8]

The “Do-It-Yourself” approach

In this model, a buying firm takes the initiative to set up a catalog, which comprises products from a fixed set of pre-qualified suppliers. This is a popular option, and has been implemented in the context of several large e-procurement projects, such as the ones deployed at Chevron or the County of Los Angeles. The approach ne-

[8] See Ginsburg, Gebauer, Segev: Bled 99-paper

cessitates a high-level of in-house IT support for front-end systems development, data collating and reconciliation.

Figure 1 shows a stylized view of the “Do-It-Yourself” approach.

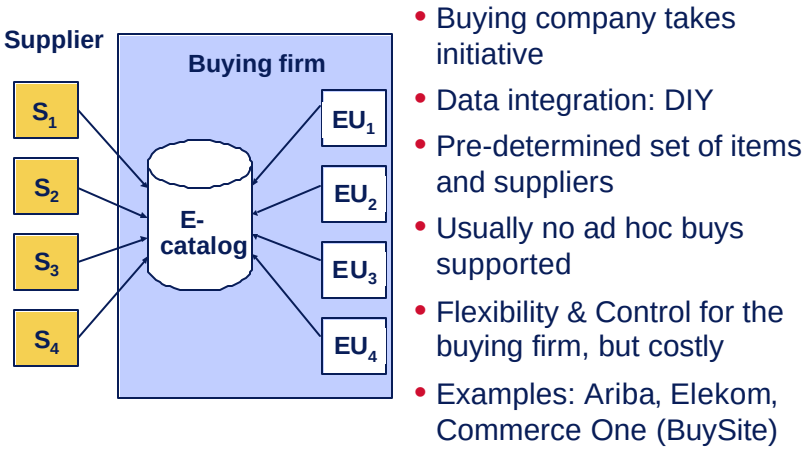

Figure 3 - The „Do-It-Yourself“ approach: The buying firm assembles its own in-house electronic catalog

It is usually the Purchasing group of the buying firm that is responsible for selecting the suppliers, for negotiating items prices, and for deciding according to which scheme each item is represented in the catalog. It decides on catalog design in terms of user interface, search mechanisms, and links with other applications such as accounting or human resources. Thus, Purchasing is responsible for weighing the intangibles as well as the tangibles of the suppliers‘ offerings. Although external support might be obtained for these tasks and for setting up, implementing, maintaining, and maybe even hosting the catalog system, the „do it yourself“ model implies that the buying company is in full control of the catalog content and system functions. Given that the participation in such a catalog project implies significant expenses for all participants, buyer and suppliers usually know each other well and consider their business relationships as long-term (see [Bakos, Brynjolfsson 1993] for a more formal explanation). In some cases, participation in an electronic catalog project is linked with a sole-sourcing offer, where the supplier is guaranteed to be the only source for a certain sets of items.Buying outside the predefined set of items and suppliers is usually not supported by the systems. Following the up front negotiations and system design tasks, catalog data is uploaded into the database.

While the “Do-It-Yourself” model leaves the initiating company with full control of the catalog system, it also tends to be a very costly solution from the viewpoint of the buying firm. Besides the availability of a large budget and sufficient in-house IT skills, it also requires significant market power to convince suppliers to join the system. The applications developed in-house will most likely be proprietary and could turn out difficult to extend and maintain in the future. The lack of integration of these applications spells poor coordination with third-party efforts or supplier IT systems,

for example Web-based supplier E-catalogs and affords very little market transparency as it does not support ad-hoc buys

For suppliers, participating in a number of such projects usually means to set up as many different ways to connect with their customers, given that no universally accepted standards exist. Weighing benefits against cost and risk, suppliers usually ask for sole-sourcing arrangements or at least long-term commitments from the buying company. As a result, "Do-it-Yourself" catalog systems usually contain very little overlap in catalog data and feature only one or two suppliers per product family, such as office supplies, MRO goods etc.

The "Third-party integrator" approach

In this model, a firm seeks help from a third party to set up a master electronic catalog and then „rents" access to parts of it, according to its individual requirements (see Figure 2). The E-catalog integrator is thus an intermediary which performs several value-adding functions associated with generic market intermediaries [Bailey and Bakos, 1997, Bakos 1998]. As such, it *aggregates* seller offerings to improve knowledge discovery on the part of the buying firm; it becomes *an agent of trust* as buyers implicitly trust selling firms that have joined voluntarily with the integration effort; it *facilitates* the market by reducing operating costs, and it *matches* buyers and sellers.

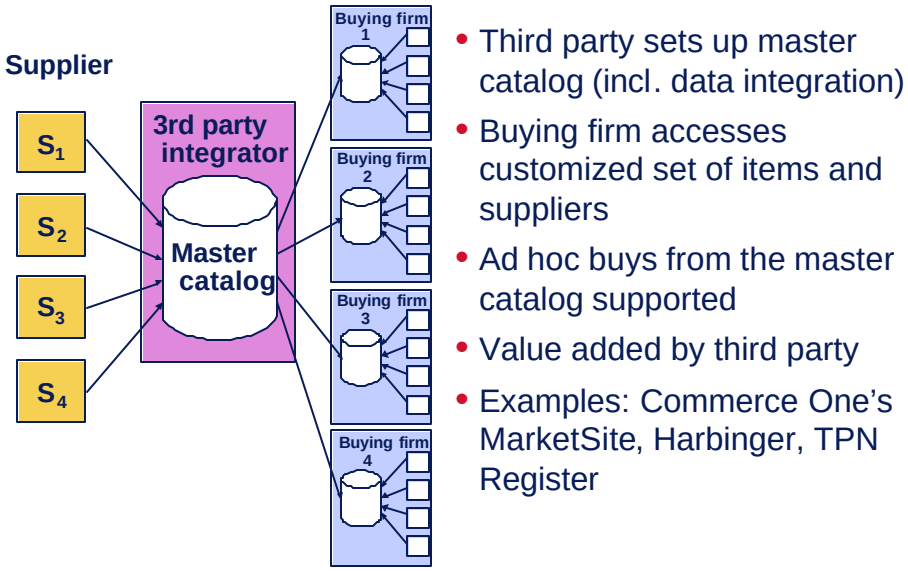

Figure 4 - A Third-Party Integrator assembles the Master Catalog

This option is often chosen by firms to lower in-house IT investment with the implicit assumption that the integrator will provide a stable and trusted set of suppliers in their collated offering.

In cases where comprehensive catalogs with data from many different and overlapping data sources are set up, the task of having to merge data from similar products becomes quite complicated. Broadly accepted standards have not yet been estab-

lished. In fact, content integrators often consider the methods they use to clean data efficiently and effectively as most critical to their business success.

While the catalog or parts of the catalog can be stored physically inside or outside of the firewall of the buying company, it is important to notice that in this model, the third party is responsible for subscribing suppliers and presenting a view of the collated data to the buying firm. Thus, it is the third party integrator who has ultimately control over the catalog content and the features of the catalog system. The integrator makes arrangements with the suppliers to participate in the catalog and manages the data uploading process. It also has main responsibility for the design and implementation of the catalog system itself, including search functionality and user interface. This is notwithstanding individual buyer-supplier agreements. Firms that are active in the field of third-party catalog solutions include Aspect, Harbinger, Requisite, TPN Register, Commerce One and ProcureNet.

Aspect Development

Aspect Development Inc. was founded in 1991 and is headquartered in Mountain View, California. Aspect's 560 employees work in offices in North America, Europe, and Asia. The company sells software, catalog content, and services. With its buy-side system Morocco MRO Solution, Aspect offers a buy-site front-end system with desktop-purchasing functionality. The system contains a catalog module that enables buying companies to integrate data from multiple vendors. Besides software tools, Aspect Development offers component and supplier reference content and services to help consolidate catalog data. It offers content management services including the identification of standardized parametric attributes for each catalog item. In its own words, Aspect addresses "strategic sourcing needs" by offering a combination of software, content, and services.

Harbinger

Atlanta-based Harbinger Corporation was founded in 1983. Today, Harbinger has more than 1,000 employees and more than 38,500 customers. Its annual revenues in 1997 were $120.7 million. The company offers a wide range of EDI and VAN services including products which integrate EDI with Internet-based technologies.

With the acquisition of Acquion, Harbinger entered the market for buy-side Web-based catalog solutions. Its major strength, however, is its ability to offer content management services as well as a large amount of available content in addition to its Web-based front-end solution. Harbinger aggregates, consolidates, and standardizes catalog data from various suppliers. It acts as an intermediary between buyers and sellers offering its services to both of them.

Requisite Technology

Requisite Technology Inc., is based in Boulder, Colorado and provides catalog technology and content services for managing product information in an electronic

commerce environment. This includes a catalog engine and tools for catalog authoring and data conversion. Requisite also offers content management services and helps small as well as large suppliers to upload their data into the Requisite Catalog which serves buying companies as a unified catalog. Requisite's technology also enables the customization of catalog content and price information according to individual contracts.

TPN Register

TPN Register is a joint venture between electronic commerce services provider GE Information Services (GEIS) and Thomas Publishing Company, publisher of the Thomas Register of American Manufacturers. Thomas Register is a catalog listing more than 60,000 products from 5,500 vendors and featuring 124,000 brands. Engineers and designers use the catalog to source for parts they need to make their products. TPN Register is an Extranet-based electronic marketplace for MRO (Maintenance, Repair and Operation) and other indirect goods and services based on Thomas Register's classification system.

The services have been developed and tested inside General Electric before they were offered to the general public in 1996. In addition to facilitating business transactions TPN Register provides business process consulting, systems integration and community management. Buying companies can use the marketplace to transmit design and engineering specifications to several of participating suppliers, which can then make bids. The system enables even small buyers to find low bidders among suppliers that would not consider them via traditional channels. Recently, a strategic alliance with Oracle has been established: the customers of Oracle's Strategic Procurement can access its resources.

In addition to the electronic market platform, TPN Register also offers its own desktop purchasing application. It helps buying organizations to provide requisitioners with controlled desktop access to approved supplier product content. Buyer-specific electronic catalogs are populated with detailed descriptions of pre-approved products at negotiated prices. Unique business rules can be applied to the customized catalog to control usage and provide detailed purchasing reports. TPN Register hosts the catalog and provides access to both buyers and sellers, so they can access information and make changes as necessary.

Commerce One (MarketSite)

With MarketSite, electronic commerce software provider Commerce One attempts to establish an electronic market for the customers of its desktop procurement product, BuySite. The extranet gives buying companies access to a huge centrally managed multi-supplier catalog. By mid 1998, 5,000 suppliers and distributors had signed up to provide content and several hundred were included in the online catalog, mostly in the context of BuySite implementations. Each buying company creates its own individual view of the MarketSite catalog by selecting a set of suppliers and

products. Purchasing people and requisitioners can then access the data set using Commerce One's BuySite purchasing software.

MarketSite provides manufacturers and distributors with the opportunity to upload their catalog data in basically in any format that is convenient for them. At minimum, suppliers need a browser and an Internet connection; Commerce One can host the data on its server. Suppliers also have the option to link their internal systems directly with the central catalog. This allows real-time interactions between sellers and buyers to exchange orders, to check product pricing and availability, and to perform status checking.

MarketSite is responsible for cleaning, validating, normalizing, and categorizing all content that is collected from the suppliers. As categorization scheme, it uses the UN/SPSC code.

ProcureNet (SmartCatalog)

ProcureNet's catalog tool, SmartCatalog, makes product data from preferred suppliers available, includes parametric search functionality and supports point and click ordering, full product specifications, and graphical catalogs.

To integrate catalog content from multiple data sources, ProcureNet, which was initiated by the Fisher Technology Group, has developed a Common Language Generator (CLG) that supports the process of data cleaning.[9] The tool captures the knowledge of material experts in a centralized database, making data rationalization a repeatable process. Pattern recognition is used to identify attributes and produce standardized format values. The CLG currently contains 90,000 rules for a wide variety of product categories, which are applied for cleaning data and establish consistent product descriptions, in combination with material intelligence. The tool can process up to 100,000 material descriptions per hour. It automates the creation of XML-tagged data, supporting the exchange of catalog content with other applications.

With PurchasePlace, ProcureNet also provides an electronic marketplace for scientific, laboratory and electronic equipment to its customers. The market serves as an additional source for products and vendors in cases where individually installed catalogs are not sufficiently covering the requirements of a buying company. By mid 1998, the market provided access to about 100 suppliers including Fisher Scientific's own 2,500-page catalog.[10] The service is provided at no fee to buyers. Suppliers pay a setup fee of $3,500 and an annual fee of $3,900 in most cases. Supplier catalogs are not integrated across different vendors.

To complement the range of products included in the marketplace, a professional purchasing team is providing support for off-contract purchases. In cases where

[9] Enabling Data for Electronic Commerce, ProcureNet Inc., White Paper, 4/9/99

[10] Clinton Wilder: E-Commerce Upgrades Set, Informationweek, June 17, 1998.

items are not included in PurchasePlace, ProcureNet staff performs sourcing and leads negotiations with suppliers. The items are then added to the marketplace, gradually reducing the number of spot-buys.

Summary

In the case of a firm with a centralized Purchasing authority, the use of a third-party integrator introduces an external intermediary. Purchasing itself, rather acts as an internal intermediary; both entities sit between the Procurement end-users (buying individuals inside the buying firm) and the suppliers. It typically acts as a filter, selecting subsets of the E-catalog to offer the end-users, such as an approved-vendor list. Value-added features such as full-text attribute search that rest on top of this catalog can be built at either, or both, of the intermediary locations.

As the number of supplier partners increases, the integrator must build scalable systems: effective search, for example, as the product universe increases.

From the perspective of the buying firm, the integrator solution could be cheaper, given that the third party takes over responsibility for signing up suppliers and setting up the database. Still, it means that an intermediary is claiming its share of the transaction. Usually, third-party integrators take fees from both, buyers and sellers, for their services. Transaction fees, charged either to the supplier, the buyer, or both, are quite common. In addition, suppliers are frequently charged for ramp-up and data conversion, depending on the quality of the data that they provide. Buyers often have to subscribe to access and use the catalog data. Altogether, third-party integrator services are usually not cheap and both, suppliers and buyers need to evaluate carefully costs and benefits that they provide to them.

In addition to the immediate access costs and benefits from receiving integrated content, buyer firms need to assess the question of what proportion of the total number of suppliers can be reached through the integrated catalog. Although catalog integrators are often very helpful in signing up new suppliers to meet the needs of their buying customers, this requires extra effort and time that has to be taken into account. Suppliers usually want to know how many of their direct competitors participate in the system alongside them and what ways the catalog offers to help them represent their offerings in an optimal way.

In addition, the availability of additional features such as tax advice, payment services, or general industry information could prove valuable. The distinction with portal approaches is not clear anymore at this point.

The "Real-Time Content Integration" Approach

In this category, the buying firm relies on advanced software techniques, for example agent-based solutions, or XML-facilitated links, to troll the Internet and locate suitable products and suppliers. Electronic catalogs are created dynamically and subsequently allow access to supplier data in real time. Examples for early applications of this model are the dynamic catalog approaches of companies like Agentics

and agent-based systems such as Kashbah etc. [Guttman Moukas Maes 1998, Nwana, et al. 1998]. Web-standard XML can play an important role to establish such dynamic links between data sources, with systems such as the ones from webMethods providing the basis technology to set them up.

Agentics

Burlington, Mass. Based Agentics offers SupplyChannel, an application that brings suppliers' catalogs into a central repository via a set of automatically updated hyper-links.

This category can be seen as part of an evolutionary development, where integrators are increasingly being bypassed and buying firms use advanced technologies for sourcing and negotiations. It is also possible to adapt heterogeneous data sources into a unified virtual schema with wrapper technology, thus creating a set of relational tables from semistructured data [Rajaraman and Norvig, 1998].

Figure 3 shows the general scheme for knowledge discovery approaches.

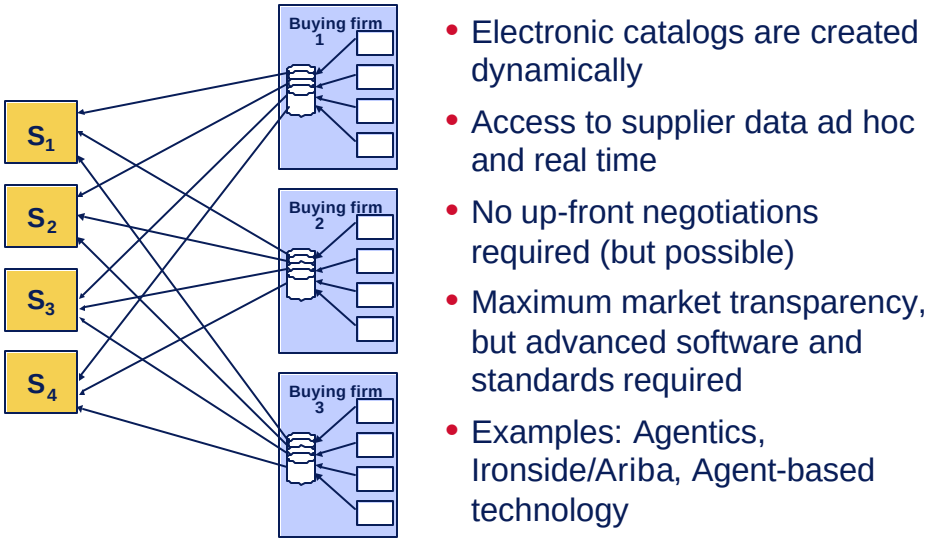

Figure 5 - In Real Time, the Buying Firms use Advanced Software Techniques to Locate, Aggregate, and Transform Supplier Data

There is no need for the suppliers to upload their catalog data into the electronic procurement systems of their customers; instead the catalogs of the suppliers are accessed as needed in any given situation. Ideally, the model does not require up front negotiations between buyers and suppliers and allows for ad hoc buys. While it provides maximum market transparency, it does rely on the availability of advanced software solutions and readily available communication protocols and product ontologies. In order to maintain control of the purchasing process and to leverage purchasing power, the model needs to provide for spending control mechanisms and

access to individually negotiated pricing schemes, in addition to ad hoc access to supplier data. Agent architectures may confront unwilling suppliers, who do not wish to compete on price discovery. Another obstacle to the application of technology in this model is the lack of standardization of product descriptions and inter-agent communication protocols.

At this point in time, available technologies are not yet mature enough to allow wide-spread diffusion of such dynamic solutions. In addition, standards to ensure ad-hoc interoperability and innovative business models need to emerge. If successful, however, the real-time integration model could have most significant impacts on procurement processes and the structure of marketplaces.

Evaluating the different approaches

The overview that we provided throughout the previous sections shows clearly the complexity of the market of catalog systems. Numerous approaches exist, combining the different functions and features into many different products and service offerings. Catalog users have to evaluate carefully, which approach to chose, taking into consideration current IT-infrastructures, in-house skills, and business requirements. Some of the relevant questions include:

- Does the catalog allow the customization and configuration of products (e.g., Dell-site)?
- What links exist to other procurement functions, such as approval routing or payment?
- Does the catalog facilitate searches across multiple supplier catalogs?
- What interfaces with backend systems exist (at the buyer site/supplier site)
- Can the catalog show individual pricing and provide a customized view of the product set?
- Does the solution guarantee unified access to a number of suppliers?
- How are non-catalog items handled? Does the system enable free-form purchasing (general Web-access, free-text forms?)
- What are the general fee structures of the providers of catalog software and services?
- What technology is used, does it match the individual IT architecture and is the solution scalable?
- Is interoperability with other catalog approaches guaranteed?

In order to be successful in the long run, catalog solution providers need to address issues such as

- Efficient ways to handle content aggregation

- Ramp-up of suppliers, accounting for individual requirements, such as EDI, Web access, ERP integration
- Allow suppliers to represent themselves on features other than price

To compare the three approaches to electronic catalogs it is useful to have a basis for comparison. In the following we introduce a framework to assess the success factors of each solution.

Each catalog model (single-vendor, "Do-It-Yourself", "Third-party integrator," and "Real-time integration" is evaluated according to a set of eight variables, addressing benefits, costs and underlying technology requirements. The variables represent the most important criteria to distinguish the different solutions as we find them in practice today. Six of the variables are focused on the buying firm and two of them take the perspective of the selling firm(s). The eight variables are summarized in Table 1 and discussed below.

Table 2 - Variables to Evaluate Electronic Catalog Models

Variable Name	Buyer Focus (B) vs. Seller Focus (S)	Depending on
Flexibility and Control	B	number of intermediaries
Purchasing and Bargaining Power	B	purchasing volume number of end users
Buyer Interface Cost	B	number of catalog partners that need a different system interface
Technology Cost	B	complexity of solution required technology knowledge)
Useability	B	control over system interface design
Catalog Reach	B	total number of items accessible via the catalog system
Supplier Adoption	S	number of competitors included in the system
Supplier Interface Cost	S	number of partners that need a different system interface

Flexibility and Control – depending on the number of intermediaries

Different electronic catalog solutions provide buying companies with different levels of control. Differences exist regarding the efforts required to adjust a solution to individual needs and changing requirements. We assume that a buying firm values a solution that provides control over the catalog content, including the possibility to decide on the set of catalog items and suppliers, as compared to a solution where flexibility is low. A highly beneficial solution should provide support for changes, even if they occur on short notice. We assume that flexibility and control are (in-

versely) dependent on the number of external third party intermediaries that are involved in setting up the electronic catalog solution.

Purchasing and bargaining power – depending on purchasing volume and the number of end users

Electronic purchasing solutions are implemented for various reasons. They can help improve day-to-day purchasing operations by automating internal workflows and external communication schemes. In addition, they can also help increase buys from preferred suppliers and, thus, allow buying firms to be better able to leverage corporate purchasing power in the future. We can assume that the success of such efforts is dependent on the intensity with which a catalog solution is used and how well it can bundle purchasing power. A big company with a large number of end user requisitioners whose buys are bundled with an electronic catalog system has generally more leverage than a small buyer with only a handful of end users. However, an electronic catalog solution that offers a supplier access to a large number of buyers and/or that aggregates the purchases of many buyers can ultimately provide the individual buyer with significant purchasing power, too.

We assume that purchasing power is mainly dependent on the number of end users with access to a specific (individual or master) catalog.

Interface cost – depending on the number of catalog partners that need a different system interface

The catalog models differ with regard to the number of interfaces that they imply. To date, no generally accepted standards and protocols for inter-organizational communication with respect to electronic catalogs exist. Earlier standards, such as EDI/EDIFACT which were suitable for simple interorganizational messages do not map well to an arbitarily extensible WWW marketspace environment (Glushko et al., 1999). Significant effort has been put into upgrading an EDI-based model into a communication format suitable for agent software but this field is still in flux. For example, XML/EDI is based on the extensible markup language (XML) to evolve EDI into a platform more suitable for e-commerce. No clear consensus has emerged in the field of e-commerce messsaging, because XML is an ad-hoc tagging scheme with no underlying semantic model (Smith and Poulter, 1999). As a result, each interface is somewhat different with regards to data structure and message contents and protocols. Electronic catalog solutions have to account for these differences, which often lead to significant costs, not only to set up a solution, but also to maintain it later on. Even in cases where a buying firm is large and enjoys great buying power, effectively utilizing such power does not come without cost. In our model, we use the number of business partners that a buying company has to deal with directly (supplier or third-party intermediary), as the main proxy for the interface cost of the electronic catalog solution.

Technology cost – depending on the sophistication of the solution and the required technology knowledge

In addition to the number of different interfaces that a catalog solution requires, the systems also differ with regards to the sophistication of the underlying technology. Other things equal, self-made solutions require a higher amount of internal technical knowledge than solutions where expertise is acquired externally.

We assume that a third-party vendor providing a sophisticated catalog solution to a number of customers might in fact be able to offer this solution at relatively low cost to the individual buying company, by leveraging economies of scale. Thus, we link the technology cost to the knowledge that the buying company has to provide in order to set up and maintain the catalog solution, be it internally available or acquired from external sources. The buying firm must also evaluate the level of data aggregation offered in the procurement solution. Often, goods which are similar along several attributes can be intelligently aggregated across multiple vendors. The question then arises whether to rely on third parties, or whether to develop aggregation strategies in-house. The question of aggregation is intimately tied to the power of the interface, as we discuss in the next point.

Useability – depending on the control over system interface design

From a corporate perspective, the benefits of each computer system are dependent on its adoption by the target user community. In the case of electronic catalog systems, this is a very important point, given that the intended leverage of purchasing power is depending heavily on its ability to gear purchases to the set of preferred suppliers, as opposed to other more random sources.

Electronic catalog systems are usually targeting a large community of end users, each of which might use the system only very infrequently. To assure high acceptance, the systems need to bedesigned in a way that makes their use easy, including graphical user interfaces, online help and documentation.

Depending on the corporate culture and professional backgrounds of a user community, each firm is somewhat different when it comes to IT skills and user interface requirements. In our model, we assume that user adoption is determined by the amount of control that the individual firm has over the design of the user interface of the system. The easier it is to control a system, the easier (and less expensive) it is to meet the requirements of targeted user community and thus ensure high acceptance. The importance of the interface cannot be underestimated. Recent work suggests two trends for a more powerful interface. Firstly, the interface should migrate from a generic to a personalized and onward to a community, or workgroup interface. Secondly, the interface should move from simple reporting of value-attribute pairs to *intelligent data analysis* (judgment and proprietary methods applied to the raw data) and finally to intelligent aggregation (intelligent analysis applied to aggregated data) [Kambil and Ginsburg, 1998].

Catalog Reach – depending on the total number of items accessible via the catalog system

Another point is relevant when it comes to determining adoption of a catalog solution: the question of whether a catalog holds all the items that a user needs access

to. This includes items that are included in the catalog database as well as items that can be accessed easily in case the database does not hold satisfying results. The higher the number of items in the catalog, the more likely it will capture everything the user needs – ideally there will be no more need to go and buy from other sources. A catalog that does not provide all possible items from the start, might still be useful by allowing access to external catalog sources. We call this feature the knowledge discovery power of a catalog solution. It is a function of the ability of buyers/end users to locate new suppliers in real time.

As a result, we use the total number of items accessible via the catalog system as the second variable to determine user adoption of a system – it includes the items that are stored in the catalog a priori as well as the items that can be included on very short notice.

Supplier adoption – depending on the number of competitors included in the system

The success of any information system is dependent on its adoption of all parties that are impacted by it. Compared to internal systems, where top management has some power to enforce the use of a system, inter-organizational solutions rely on the acceptance of at least two autonomous decision units. Thus, in order to estimate the success of a boundary-spanning system, we need to include the perspective of the business partners and determine the likeliness with which they join the system [Buxmann and Gebauer 1999].

We assume that supplier adoption is dependent on the benefits that a system provides to the individual supplier. In some cases, these benefits are directly opposed to the benefits for the buying company, resulting in interesting trade-offs. One such variable is the number of direct competitors that are included in an electronic catalog system. While for the buying company, a large number of suppliers is beneficial in terms of revealing the best deals, a supplier is more likely to object to this transparency. Economic theory shows that profit margins converge toward zero in markets with perfect transparency regarding product quality, delivery terms, and prices [Bakos 1991], [Bakos and Brynjolffson 1993].

In our model, we assume that supplier adoption is inversely related with the number of competitors included in the system.

Supplier interface cost – depending on the number of partners that need a different system interface

Supplier adoption might also depend on the cost required to join the system. Corresponding to the number of interfaces that a buying firm has to provide for, the catalog models also differ with regards to the efforts that are required from the supplier side. Again, we cannot assume that interfaces are standardized in terms of communication protocols and product ontologies. We assume that the costs of establishing electronic links with trading partners are significantly greater than zero as long as standardized interfaces are not readily available.

As a result, supplier adoption is directly related to the number of different interfaces that a system has to accommodate. These costs include the expenses to set up the technical infrastructure to link with an electronic catalog solution.

Table 3 ranks the four catalog models with respect to the variables that we introduced in Table 2.

Table 3 - Evaluating electronic catalog models from the perspective of buyer (B) and supplier (S)

	Single-vendor/sell-side solution	**Do It Yourself** (in-house catalog, few suppliers, no ad hoc buys)	**Third Party Integator** (catalog maintained by external party, buyer subscribes to part of the full catalog)	**Real-Time content aggregation**, e.g. agents (inhouse catalog, many suppliers, ad hoc buys supported)
Flexibility and control – determined by the number of intermediaries (B)	+ (lowest)	+++ (high/medium)	++ (low)	++++ (highest)
Purchasing and bargaining power – determined by purchasing volume and number of end users (B)	+ (low)	++ (medium)	+++ (highest)	+ (lowest)
Cost – determined by the number of different catalog partners (B)	++ (very high)	+++ (high)	++++ (lowest)	+ (highest)
Technology Cost -determined by the internal knowledge that is required (B)	+ (least)	+++ (medium)	++ (little)	+ (most)
Useability – determined by the ease of the user interface (B)	++ (difficult)	++++ (easy)	+++ (medium)	+ (most difficult)
Catalog Reach – determined by the items in the catalog (B)	+ (lowest)	++ (low)	++ (medium)	++++ (best)

Supplier adoption – determined by the number of competitors (S)	++++ (best)	+++ (good)	++ (medium)	+ (least)
Supplier interface cost – determined by the number of interfaces (S)	++++ (least)	+ (most)	++ (most)	+++ (few)

There are some indications that Table 3 shows an evolutionary path from left to right. As research by Forrester indicates, sell-side solutions dominate currently in terms of revenues that they create. However, buy-site systems are expected to take a greater share in the near future and, already a large number of e-catalog projects fall into this category, the Do-it-Yourself approach. Typically, large corporations, often with dispersed buying communities, hope to streamline their purchasing processes and improve the leverage of their purchasing power by establishing multi-vendor catalog systems. Recently, however, the third-party integrator approach has become more popular, in particular in the context of procurement portals, as renting access to parts of a master catalog is a more affordable option for smaller corporations than the costly Do-it-Yourself approach. Over time, both weaknesses in the third party integrator model and growing ease of use of advanced internet mining techniques might well give the firm incentive to switch partially or entirely to a real-time catalog integration model.

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